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20 JAN 1999



INVESTOR IN PEOPLE

The Patent Office
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NP9 1RH

GB 98/03797

REC'D	08 FEB 1999
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I also certify that by virtue of an assignment registered under the Patents Act 1977, the application is now proceeding in the name as substituted.

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GB9727107.6

By virtue of a direction given under Section 30 of the Patents Act 1977, the application is proceeding in the name of

CORALTECH LIMITED

Hill Hampton

East Meon

PETERSFIELD

Hampshire

GU32 1QN

United Kingdom

Incorporated in the United Kingdom

[ADP No. 07209638001]

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Patents Form 1/77

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The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference

1491

2. Patent application number

(The Patent Office will fill in this part)

23 DEC 1997

9727107.6

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Coralfoam Limited
Hill Hampton
East Meon
Petersfield
Hampshire

GU32 1QN

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

United Kingdom

SECTION 30 APPLICATION FILED 14-4-98

4. Title of the invention

MOULDED ARTICLE

5. Name of your agent (if you have one)

NIGEL BROOKS CPA

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

HILL HAMPTON
EAST MEON
PETERSFIELD
HAMPSHIRE

GU32 1QN

Patents ADP number (if you know it)

463001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
(if you know it)

Date of filing
(day / month / year)

GB

na

NA

NA

NA

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

NO

- a) any applicant named in part 3 is not an inventor, or
 - b) there is an inventor who is not named as an applicant, or
 - c) any named applicant is a corporate body.
- See note (d))

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Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	0
Request for preliminary examination and search (Patents Form 9/77)	0
Request for substantive examination (Patents Form 10/77)	0
Any other documents (please specify)	

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date

23/12/97

12. Name and daytime telephone number of person to contact in the United Kingdom

NIGEL BROOKS CPA (01730) 823647

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Moulded Article

The present invention relates to a method of forming an article via injection of plastics material into a mould.

5

Various methods of forming thermoplastics materials into articles are known:

1. Injection moulding involves injection of the material into a mould, which is filled. The material solidifies in the mould and takes up its shape. The general rule is that the wall thickness of the article, that is the gap between opposite parts of the
10 mould should be uniform. There is a practical limitation on the wall thickness, in that it is difficult to mould walls thinner than the order of 0.3mm. With thinner wall thickness, the mould becomes very difficult to fill completely and reliably. This is because a long thin passage for the material exists from the injection port into the mould to the opposite end of the article. The so called flow length: thickness ratio is
15 too high. The result is that injection moulding is impractical and/or uneconomic for certain classes of product, such as vending machine cups.

2. Injection/blow moulding is a process whereby the wall thickness of an article initially formed by injection is reduced by blowing the article to a large diameter – or other cross-sectional dimension. In an injection/blow moulding process, the initially
20 formed article – the preform – is indexed from the original cavity to another cavity into whose shape it is to be blown. The process of indexing, coupled with adequate cooling of the preform before opening of the initial cavity away from the core results in the preform being likely to be too cool for blowing immediately on introduction into the second cavity. Further, cooling of the preform gives it stability for the
25 indexing. After indexing, a delay is necessary before blowing with gas pressure at the core side, to allow for heat soak from the core to warm the preform again to a plastic state. Consequently, injection/blow moulding is a relatively slow process, but nevertheless widely used for bottle production.

3. An alternative, especially for wide mouth containers is for the material to be
30 thermoformed. In this process, an extruded sheet is peripherally gripped and blown into a cavity. The process stretches the material and a wall thickness less than that practical with injection moulding can be achieved. Usually the result is an uneven wall thickness, with a thicker wall in a base of the article and a thinner wall in its

sides. Further there is liable to be wastage at the periphery and in gaps between successive articles formed from the extrusion.

The object of the present invention is to provide an improved method of forming a plastics article.

According to the invention there is provided a method of forming a plastics material article, consisting in the steps of:

forming an injection moulded preform between core and first cavity mould parts,
separating the first cavity mould part from the preform,
assembling a second, larger cavity mould around the preform and
blowing the preform away from the core part into a finished article shape.

It should be noted that whilst the above statement refers to the withdrawn and second, assembled moulded parts as "cavities", it is conceivable - though unlikely - that they could be convex.

The process differs from the conventional injection/blow moulding process in that the mould parts are not indexed as such. In an indexing mould tool, the preform is withdrawn from the initial cavity and moved to the second cavity, whilst simultaneously another core part is introduced into the first cavity part. Injection and blowing occurs simultaneously at the two cavities. Whilst this may seem to have advantage in producing a finished article for each indexing step, the cycle time is determined by the time required for cooling the preform, indexing and reheating the plastics material to plastic state after cooling for indexing. In the method of the invention, the first cavity mould part is preferably separated early, the second cavity assembled without delay and the preform blown quickly. It is anticipated that the cycle time will be of the order of 2.5 seconds, in comparison to a typical 5.0 seconds cycle for conventional injection blow moulding.

In the method of the invention, the preform does not move transversely of the machine, although it is likely to move axially - injection having been via an injection gate in the first cavity part. The preform remains in contact with the core at a

temperature suitable for plastic extension. Further, because there is axial movement only of the preform, the initial cavity can be removed early, as soon as the plastics material has been cooled, preferably mostly by the first cavity part, to a sufficient extent to hold its shape. The material skins against the first cavity mould part at least prior to withdrawal of the latter. However, the material is unlikely to be solid throughout its thickness (which, it should be remembered is about to be reduced) with the central region of the wall remaining hotter and more flexible. Thus heat soak is able to occur into the skin rendering the entire wall sufficiently flexible to stretch into the second cavity.

Whilst in theory the advantage of such early opening can be combined with an index movement of the second cavity part, a faster cycle time is achieved by assembling the second cavity. The assembly can be from parts moved in radially. However in the preferred embodiment, secondary cavity parts are pivotally mounted. They can be driven by a collar which in one position opens the pivoted cavity parts and in another position closes them. Thus a plurality of cavity parts can be ganged together and moved by a single actuator.

In the preferred embodiment, the preform is stretched to reduce its average wall thickness by a third. This ratio could be between a quarter and a half, but is unlikely to be substantially greater reduction in wall thickness.

To help understanding of the invention, a specific embodiment thereof will now be described by way of example and with reference to the accompanying drawings, in which,

Figure 1 is a cross-sectional side view of a mould tool use in the invention, with a primary cavity closed;

Figure 2 is a similar view of the mould tool with a secondary cavity closed;

Figure 3 is an end view, from the right in Figure 2, of the closed petals forming the secondary cavity;

Figure 4 is a cross-sectional side view of the preform of Figure 1; and

Figure 5 is a similar view of the end product of Figure 2.

Referring to the drawings, the mould tool comprises a primary cavity 1, a core 2, a secondary cavity petals 3 and an actuation ring 4. The primary cavity 1 is attached to the fixed platen (not shown) of moulding machine in use and incorporates an injection gate 11, temperature control passages 12 and an ejection poppet valve 13.

The core 2 is attached to the moving platten (not shown), has temperature control passages 21, a blowing air valve 22 with its own temperature control passages 23 and four pivot points 24 for the secondary cavity petals 3, of which there are four.

The petals 3 have their own temperature control passages 31. They are generally L shaped and pivotally connected to the core at the elbow 32 of the L, which is rather more open than a conventional L. The feet 33 of the L chiefly comprise an "opening" surface 34, whilst the limbs of the L comprise a "closure" surface 35 on one side and a cavity surface 36 on the other side. They also comprise abutment surfaces 37 which mutually abut when the petals are closed to form the secondary cavity. Air bleeds 38 are provided.

The ring 4 carries four roller supports 41 having rollers 42 for co-operating with the opening and closure surfaces 34,35 and buffers 43,44. The ring is slidably supported on four bars 45.

In use, the ring 4 is withdrawn by a hydraulic ejection actuator (not shown) in the direction away from the primary cavity 1 and the core 2 is advanced into contact with the primary cavity, as shown in Figure 1. The preform 5 shape so defined is for a cup. It has a wall thickness 51 of 0.3mm except at the rim 52, which is thicker for foaming expansion. Within 0.2 sec. of the end of the injection of plastics material through the gate 11 to fill the mould gap between the core and the primary cavity, with a skin just formed against the cavity, the core 2 is withdrawn with application of air pressure to the poppet valve 13, whereby the moulded preform is withdrawn with the core.

As soon as the core is withdrawn sufficiently for mechanical clearance, the ring 4 is advanced. The rollers 42 leave the opening surfaces 34 and the forward buffers 43 knock the petals forward. The rollers then engage the closure surfaces 35

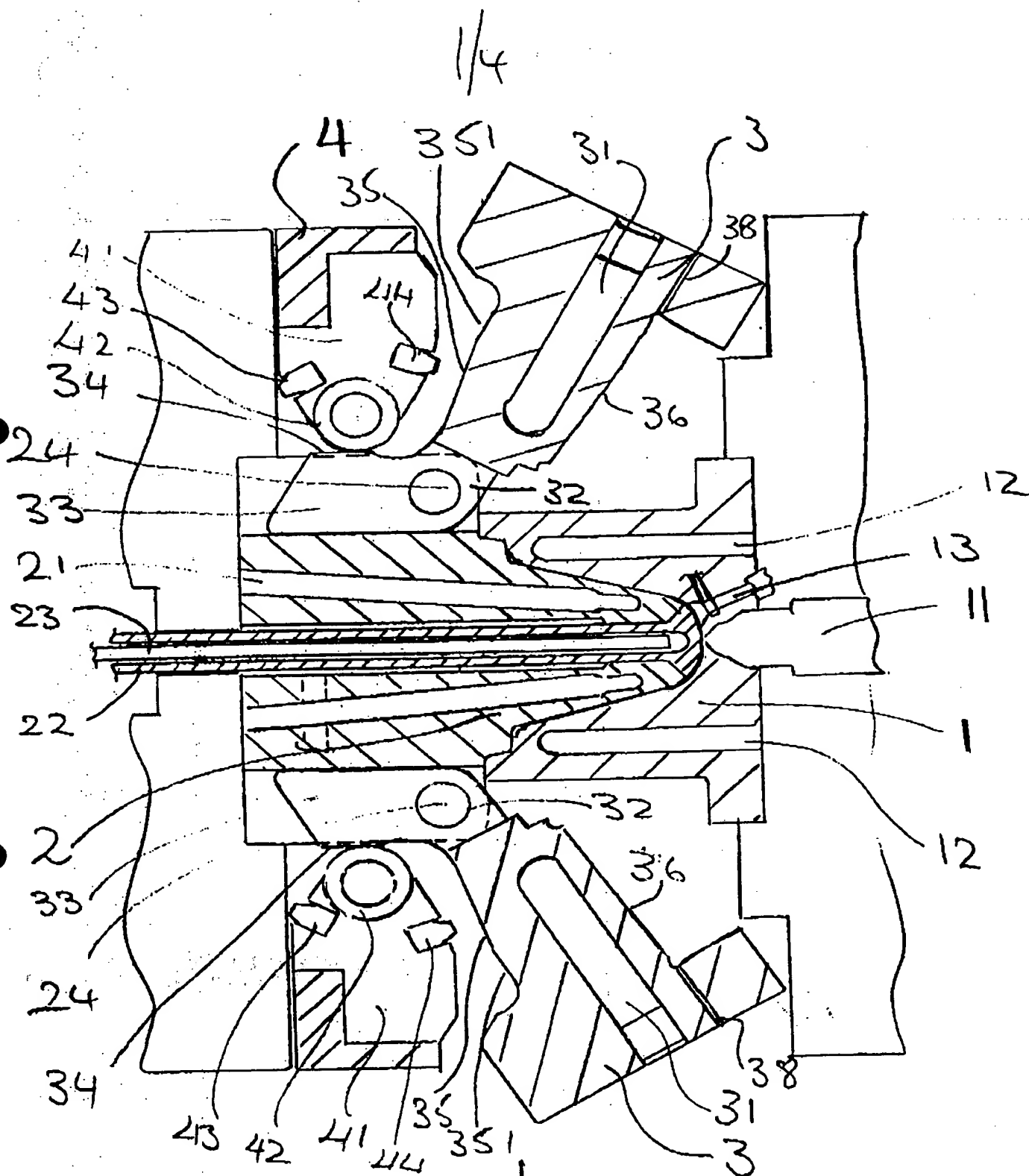
as the petals 3 swing closed about the pivots 24. The surfaces 35 have parallel ends 351, whereby when limit surfaces 45,39 on the roller supports and the petals engage, the petals are firmly held closed, see Figure 2. This position is reached within 0.5 sec. of core withdrawal, whereupon gas - suitably nitrogen at 40 bar - is blown through the valve 22 and the preform is expanded into the secondary cavity, to take up the shape 6 of the finished product. It should be noted that the petals have a groove 361 for allowing the rim 52 to expand. The typical wall thickness of the finished product is 0.2mm.

10 Immediately after blowing, the ring 4 is withdrawn, the rear buffers 44 knock the petals open and product falls from the tool. The latter can now close again for the next cycle. The total cycle time is expected to be 2 ½ seconds.

15 Temperature control is important - as always in injection moulding. It is to be expected that the primary cavity and the petals will be run cold, respectively to cause the preform to skin and allow early opening and to cause the blown product to become rigid for early opening of the petals. However, it is expected that the core will be run warmer, so as to allow the preform to be in a state able to expand plastically when the gas is blown into the mould tool.

20 The invention is not restricted to the details of the above described embodiment. For instance the finished product as described is a circular cup. However, a rectangular container can be made by the method of the invention. For such, the four petals, shown in Figure 3 as meeting in a cross formation, may meet in 25 a double/stem-to-stem Y formation, that is with two petals abutting at the stems of the Y's and two other petals having points filling the gaps in the heads of the Y's. Further more or less than four petals may be provided. Further for products having particularly vulnerable areas, such as corners, the wall thickness of the preform may be increased in areas stretching into the vulnerable areas, to reinforce them.

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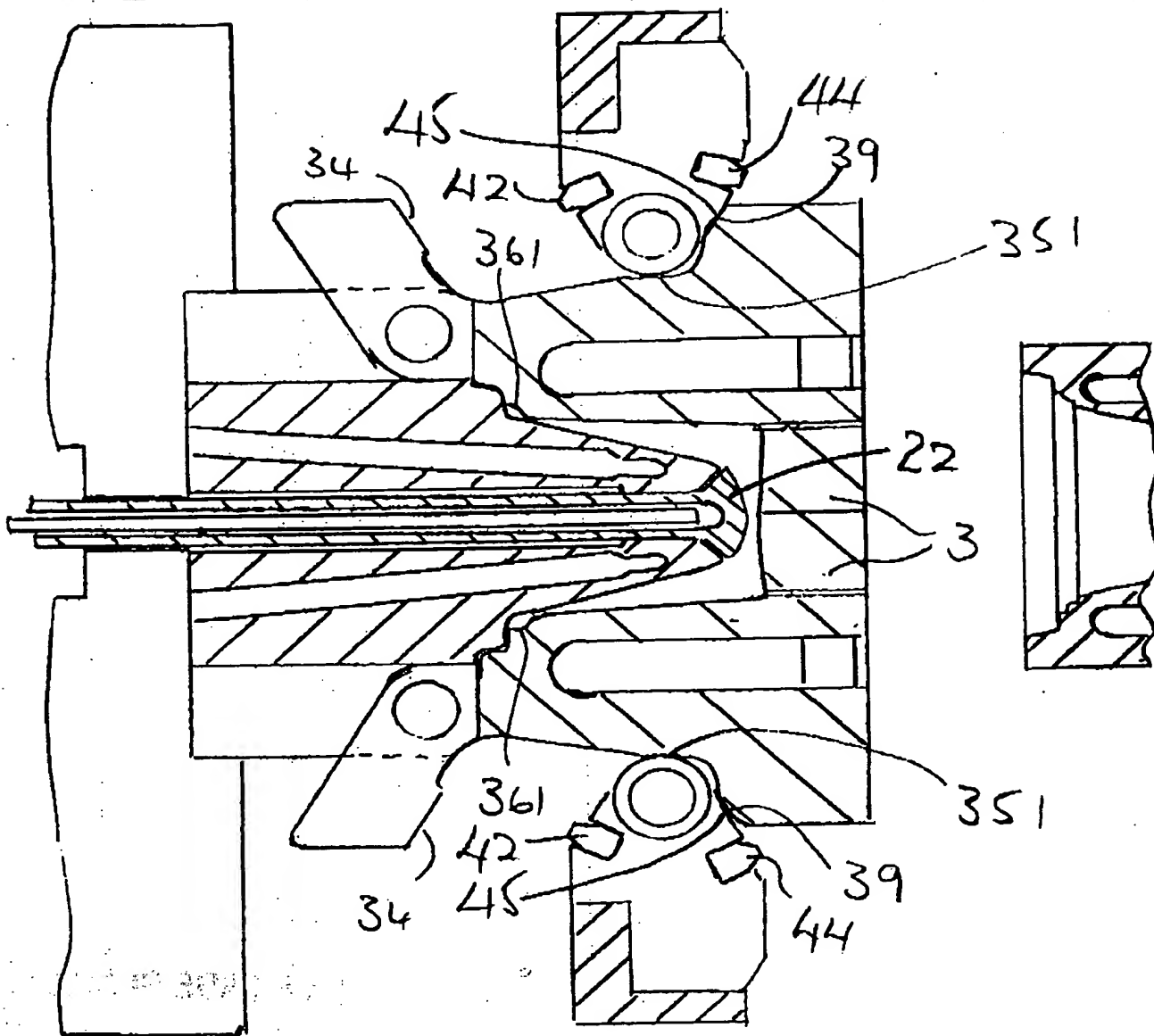


FIGURE 2

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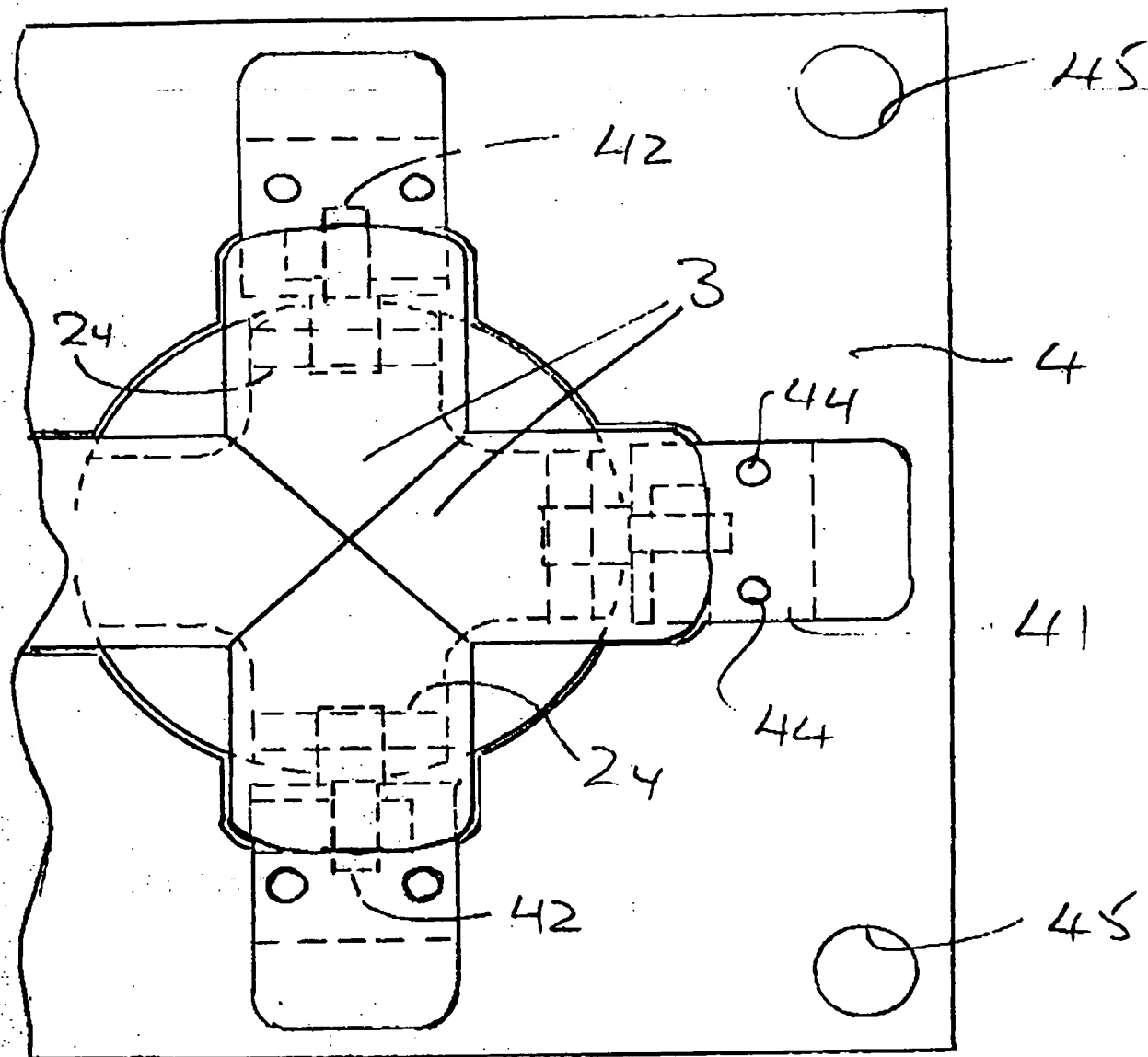


Figure 3

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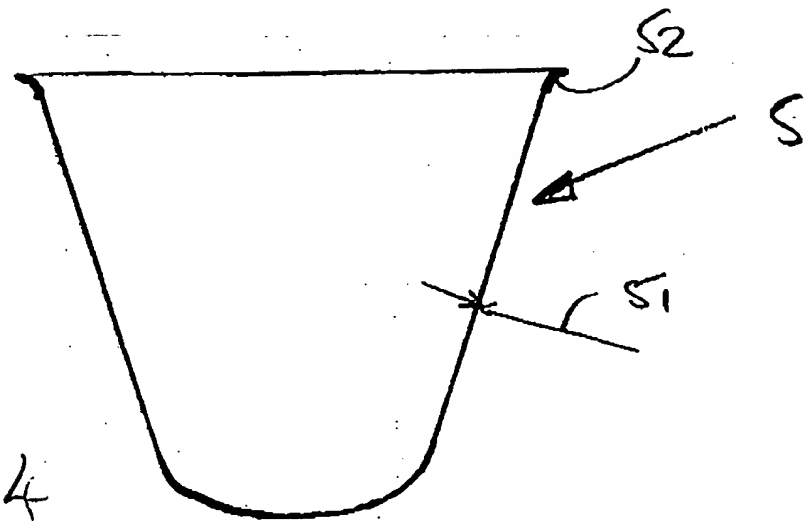


FIGURE 4

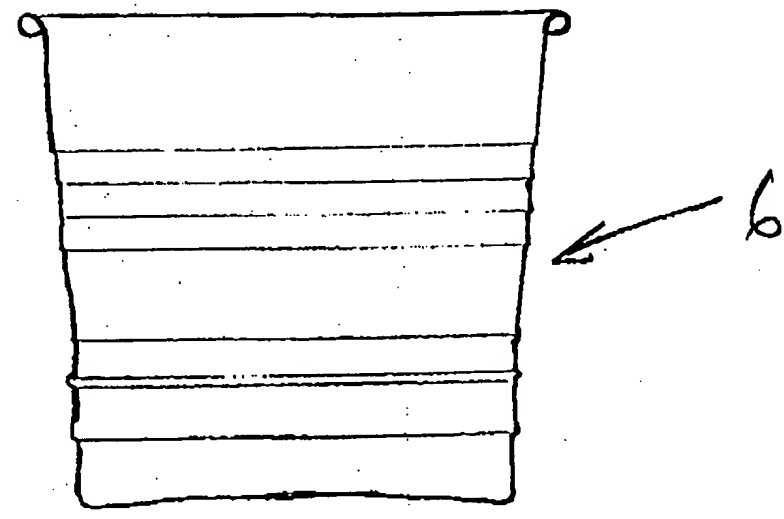


FIGURE 5

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